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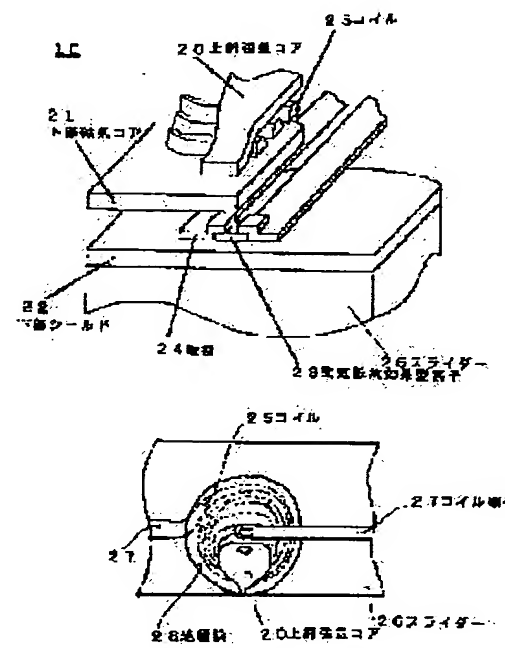
(54) PRODUCTION OF THIN-FILM MAGNETIC HEAD, THIN-FILM MAGNETIC HEAD AND MAGNETIC STORAGE DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a thin-film magnetic head having a magnetic thin-film material which has a high saturation magnetic flux density suitable for a higher recording density in a high-frequency region and having high specific resistance.
SOLUTION: The production of magnetic cores 20, 21 of the thin-film magnetic head is executed by a flame plating method. The plating bath for this method is an electroplating bath for Ni-Fe allay thin films which contains 3.5 to 10g/l Ni++ ion, 0.5 to 1.6g/l Fe++ ions as its compsn., is set with the range of metal ion concn. so as to attain 6 to 8 in the ion ratio (Ni++/Fe++) of the Ni++ and Fe++, contains a solvent added with an ordinary used stress relieving agent and surfactant and is set at pH of 2.5 to 3.5. The current density is set in a range of 5 to 30mA/cm2 by using this plating bath. The plating bath is so prepd. as to contain at least one of sodium molybdate, sodium tungstate and chromium chloride alone or in combination at 0.01 to 1.0g/l.



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CLAIMS

[Claim(s)]
[Claim 1] In the manufacture method of the thin film magnetic head for record of record / reproduction discrete-type magnetic head, the magnetic core of the aforementioned thin film magnetic head is manufactured by the frame plating method. the plating bath As the composition, it is 3.5 g/l - 10 g/l. nickel++ ion and the Fe++ ion of 0.5 g/l - 1.6 g/l are included. And a metal ion density range is set up so that the ion ratio (nickel++/Fe++) of nickel++ and Fe++ may be set to 6-8. Usually, it is the electroplating bath of the nickel-Fe alloy thin film by which pH was set as 2.5-3.5 including the solvent which added the stress relaxation agent and surfactant which are used. This plating bath is used and it is current density 5 mA/cm2 - 30 mA/cm2 The manufacture method of the thin film magnetic head characterized by setting it as the range and carrying out plating formation.
[Claim 2] In the manufacture method of the thin film magnetic head for record of record / reproduction discrete-type magnetic head, the magnetic core of the aforementioned thin film magnetic head is manufactured by the frame plating method. the plating bath As the composition, it is 3.5 g/l - 10 g/l. nickel++ ion and the Fe++ ion of 0.5 g/l - 1.6 g/l are included. And it is made for the ion ratio (nickel++/Fe++) of nickel++ and Fe++ to be set to 6-8. furthermore, a sodium molybdate and a sodium tungstate -- and Or a metal ion density range is set up. independent in at least one of the chromium chlorides -- so that it may mix and 0.01 g/l - 1.0 g/l may be included Usually, it is the electroplating bath of the nickel-Fe alloy thin film by which pH was set as 2.5-3.5 including the solvent which added the stress relaxation agent and surfactant which are used. This plating bath is used and it is current density 5 mA/cm2 - 30 mA/cm2 The manufacture method of the thin film magnetic head characterized by setting it as the range and carrying out plating formation.
[Claim 3] The manufacture method of the thin film magnetic head according to claim 1 or 2 characterized by holding the temperature of the aforementioned plating bath at 20 degrees C - 35 degrees C, and carrying out plating formation into a magnetic field.
[Claim 4] The manufacture method of the thin film magnetic head according to claim 1, 2, or 3 characterized by heat-treating the substrate which has the magnetic core by which plating formation was carried out [aforementioned] in a magnetic field for 0.5 hours to 3 hours by 180-degree-C or more temperature requirement 300 degrees C or less.
[Claim 5] In the thin film magnetic head for record of record / reproduction discrete-type magnetic head the aforementioned thin film magnetic head It is manufactured by the manufacture method of the thin film magnetic head one publication a claim 1 or among 4. The magnetic core of the aforementioned thin film MAG beef fat uses as the base the 2 yuan alloy thin film which has Fe:50wt% - 60wt% nickel:40wt% - 50wt% by the weight ratio. it -- respectively -- independent -- molybdenum -- less than [3wt%] and chromium -- less than [4wt%] and a tungsten -- less than [1.5wt%] -- it was made to contain -- Or it is these at least two by synthesis 3wt(s)% - 4wt% The thin film magnetic head characterized by the bird clapper of 3 yuan made to contain, 4 yuan, or 5 yuan from the thin film the thickness of whose it is an alloy thin film and is 1 micrometer - 5 micrometers.
[Claim 6] Magnetic storage characterized by constituting record / reproduction discrete-type

magnetic head in the magnetic storage constituted by having using the thin film magnetic head according to claim 5 as the thin film magnetic head for record of the aforementioned record / reproduction discrete-type magnetic head.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the manufacture method, the thin film magnetic head, and magnetic storage of the thin film magnetic head, and relates to the manufacture method of the thin film magnetic head for record of record / reproduction discrete-type magnetic head which can perform record of high recording density especially, the thin film magnetic head manufactured by that cause, and the magnetic storage which used this thin film magnetic head.
[0002]
[Description of the Prior Art] In recent years, with the raise in the recording density of a magnetic disk unit, high coercive force-ization of a record medium progresses and the thin film magnetic head which has sufficient record capacity to such a record medium of high coercive force is demanded. Therefore, this kind of magnetic head needs to constitute using a high material of saturation magnetic flux density (Bs) as core materials of the magnetic head. And 80% nickel-Fe alloy film whose thickness is about 3 micrometers has been conventionally used as such material.
[0003] However, for this 80%nickel-Fe alloy film, specific resistance is 16microomegacm - 20microomegacm. Since it is low, eddy current loss is large, for this reason, the record magnetic field strength in a RF field falls, and at most about 30MHz of the record frequency of the magnetic head using this kind of alloy film is a limit. Moreover, as a material replaced with this, although Co system amorphous materials, the Fe-aluminum-Si system SENDATO alloy thin film, etc. are proposed and the former is amorphous therefore, it is thermally unstable, and the latter is 500 degrees C. Heat treatment by the high temperature of a grade is required. For this reason, such material has a difficulty in manufacture process as magnetic-core material for magnetic disks, and has not resulted in utilization.
[0004] Moreover, it is Co-nickel-Fe as a magnetic-core material for the recently and thin film magnetic heads. Although the 3 yuan system material to depend was indicated and proposed by JP,60-82638,A, JP,64-8605,A, JP,2-68906,A, etc., such 3 yuan system material had a difficulty in the RF property like 80%nickel-Fe alloy film, since specific resistance was 12microomegacm - 18microomegacm and a small value, although saturation magnetic flux density (Bs) was as high as more than 1.5T.
[0005] On the other hand, the storage capacity of a magnetic disk unit is 3.5 which is increasing certainly every year and is produced commercially now. The field recording density of the magnetic disk unit which uses the disk of an inch is raised to 2 350 Mb(s)/inch at the maximum. The data-logging frequency in the head in this case is about 27MHz, and is approaching the performance limit of the magnetic head using conventional 80%nickel-Fe alloy film or a conventional Co-nickel-Fe alloy film.
[0006] Moreover, the magnetic film formed as a magnetic film for RFs by the sputtering method which added Nb, Ta, Cr, Mo, etc. to nickel-Fe 40 to 55% is indicated and proposed by JP,3-68744,A etc. However, since the material of this magnetic film has the large crystal magnetic anisotropy, it is difficult to form the thick film by the sputtering method in magnetic properties.

[0007] Furthermore, crystal grain can be made detailed, and although the galvanizing method which can mitigate the influence of a crystal magnetic anisotropy is indicated and proposed by JP,4-63412,A etc., this method cannot form the magnetic film which can not necessarily be satisfied, when mass-production nature is taken into consideration.
[0008] As mentioned above, as a magnetic film for the magnetic heads which can perform record of the high recording density in a RF field, saturation magnetic flux density (Bs) is large, and material with large specific resistance is required small [the coercive force of difficult shaft orientations]. Well-known bulk material is known as a material which can meet those demands by;FERROMAGNETISM written by Bozorth etc.
[0009] and -- according to the writing of Above Bozorth in the composition range to which specific resistance becomes the largest with nickel-Fe the alloy of 2 yuan -- nickel:30wt% -- it is order However, the saturation magnetic flux density of the neighborhood is a field to which it falls rapidly, and is unstable. And specific resistance is also high and the composition field where saturation magnetic flux density is also high is nickel:40wt% - 60wt%. It is a range. Moreover, since this composition field is a range with the largest crystal magnetic anisotropy, when [which usually produces the magnetic film of a thick film 2 micrometers or more by the sputtering method etc.] applied to the thin film magnetic head etc., membranous crystal grain will become large. For this reason, the magnetic film produced by this method has large coercive force, and a uniaxial anisotropy is hard to give. Moreover, since a magnetostriction constant has a positive large value, it is not put in practical use as a charge of thin film magnetic-head material.
[0010]
[Problem(s) to be Solved by the Invention] as mentioned above, in order that it may be difficult for the magnetic film for the magnetic heads by the conventional technology to make high record frequency of the magnetic head which the record magnetic field strength in a RF field fell, and used this or it may consider as magnetic-core material, it has troubles, like a difficulty is in the manufacture process
[0011] The purpose of this invention solves the trouble of the aforementioned conventional technology, develops the magnetic-thin-film material which is the high saturation magnetic flux density suitable for high recording-density-ization in a RF field, and has high specific resistance, and is to offer the manufacture method of of the rapid access and the thin film magnetic head which can respond to fast transmission which can perform record of high recording density in a RF field, the thin film magnetic head which were manufactured by that cause, and the magnetic storage which used this thin film magnetic head.
[0012] The magnetic disk unit for the purpose of this invention making fast transmission and high recording density attain speaking concretely Namely, a magnetic disk is 4000rpm at the time of record and reproduction of a magnetic disk unit. It rotates above. The record frequency of a recording head is to offer the manufacture method of the thin film magnetic head that it can carry in the magnetic storage set as 45MHz or more, and the performance can be demonstrated, the thin film magnetic head manufactured by that cause, and the magnetic storage which used this thin film magnetic head.
[0013]
[Means for Solving the Problem] According to this invention, the aforementioned purpose is set to the manufacture method of the thin film magnetic head for record of record / reproduction discrete-type magnetic head. The magnetic core of the aforementioned thin film magnetic head is manufactured by the frame plating method. the plating bath As the composition, it is 3.5 g/l - 10 g/l. nickel++ ion and the Fe++ ion of 0.5 g/l - 1.6 g/l are included. And ion ratio (nickel++/Fe++) of nickel++ and Fe++ A metal ion density range is set up so that it may be set to 6-8. Usually, it is the electroplating bath of the nickel-Fe alloy thin film by which pH was set as 2.5-3.5 including the solvent which added the stress relaxation agent and surfactant which are used. This plating bath is used and it is current density 2-30mA [/cm] 5 mA/cm 2 It is attained by setting it as the range and carrying out plating formation.
[0014] Moreover, during a plating bath, the aforementioned purpose is attained in one independent or by mixing and making it 0.01 g/l - 1.0 g/l included, even if there are still few sodium molybdates, sodium tungstates, and chromium chlorides.

[0015] Furthermore, the aforementioned purpose is attained by including record / reproduction discrete-type magnetic head with the thin film magnetic head formed of the above-mentioned in magnetic storage, and constituting magnetic storage.
[0016]
[Function] In order that this invention may raise specific resistance by the conventional galvanizing method in the range which does not lower the saturation magnetic flux density of a magnetic film 40 to 60% based on the 2 yuan system alloy by nickel-Fe The 3rd element of molybdenum (Mo), chromium (Cr), and a tungsten (W) is added. As a result of examining various plating conditions, after securing 2 micrometers - 5 micrometers of thickness which acquires a required record magnetic field, they are more than saturation-magnetic-flux-density (Bs):1.5T and coercive force (HCH):1.0Oe. Below And the composition range and its manufacture method of the outstanding magnetic thin film which has 40 or more microomegacm of specific resistance are found out. And the highly efficient magnetic storage of more than field recording density:500Mb/inch2, more than record frequency:45MHz, and 15 or more MB/s of transfer rates can be offered by using for the thin film magnetic head the material produced by the above-mentioned manufacture method.
[0017] Generally, it is known that the nickel-Fe system plating of 2 yuan makes an unusual deposit occur. And although remarkable research is made by composition near nickel-Fe 80% and there is also much data, there is little data at composition of Fe-rich. Then, this invention person etc. fixes the boric acid as an additive of a plating bath usually used in the galvanizing method, NaCl, the saccharin sodium, the sodium lauryl sulfate, etc., and is changed the amount of Fe ion which participates in plating directly into 0.5 g/l - 1.2 g/l, the amount of nickel ion is changed into the range of 3.5 g/l - 10 g/l, and they are 5 mA/cm2 - 30 mA/cm2, and pH about plating-current density. It changed and inquired in the range of 2.5-3.0. Consequently, the stable amount of proper ion of a plating bath suitable for the productivity for forming the magnetic thin film of 40 - 50%nickel-Fe which has suitable magnetic properties, and the magnetic thin film used for the magnetic core which added any one of Mo, Co, and the W to this composition and pH A value and current density were able to be found out and the method of heat-treating in the magnetic field for forming the still more suitable magnetic-domain structure as the magnetic head was able to be found out.
[0018] That is, FeSO4.7H2O is used for this invention as the Fe ion source of the plating bath in the above-mentioned galvanizing method, and NiCl2.6H2O and NiSO4.6H2O are used as the nickel ion source. And an important thing is making the amount of Fe ion of a plating bath into the range of 0.5 g/l - 2.0 g/l in this invention.
[0019] if one of the reason of this has too few amounts of Fe ion of a plating bath, in order not to become Fe content of a request of the formed magnetic thin film and to make Fe content in a magnetic thin film desired Fe content -- plating-current density -- 5 mA/cm2 the following -- small -- not carrying out -- it does not obtain but is because change of magnetic properties is not greatly practical, either the top whose plating efficiency is bad and is not practical Moreover, other one of the reasons is because a problem arises when there are too many amounts of Fe ion of a plating bath.
[0020] That is, if there are too many amounts of Fe ion of a plating bath, although Fe content in a magnetic thin film will exceed desired Fe content, by adjusting the amount of nickel in a plating bath, it is possible to make Fe content in a magnetic thin film into desired Fe content, and a magnetic-properties-problem does not arise on a plating film. However, if the amount of Fe ion of a plating bath increases, Fe ion under plating bath becomes unstable, trivalent Fe ion which does not contribute to plating is generated during a plating bath, serves as a hydration oxide, it precipitates during a bath, the divalent amount of Fe ion which contributes to plating is changed, and it is pH of a bath. It will be made to change.
[0021] Drawing 1 is pH of the plating bath at the time of changing Fe ion concentration of a plating bath. It is drawing explaining time change and this is explained hereafter.
[0022] In drawing 1 , a curve (B) and (C) are the plating baths which lessened the amount of Fe ion, and a curve (A) is an example of a property at the time of carrying out the amount of Fe ion in 1.2 g/l and 0.4g/l., respectively, when the amount of Fe ion of a plating bath is made into 2.3

g/l. When the amount of Fe ion is (A) which is 2.3g/about l so that drawing 1 may show, **** occurs during a plating bath with time, and it is pH of a plating bath. In (B) which lessened the amount of Fe ion and was made into the proper amount although it changed, and (C), it is pH of a plating bath. It can hold stably and generating of the hydration oxide of Fe used as ****** can also be prevented.
[0023] It is nickel-Fe industrially. If a hydration oxide is generated in a plating bath when galvanizing, this hydration oxide becomes [block a filter and / ion-tube ** of a plating bath] complicated and is not desirable. Therefore, it is important for the proper amount of Fe ion to hold down to the range of 0.5 g/l - 1.6 g/l. And desired 40 - 50%nickel-Fe In order to obtain a plating film, it is good to adjust the amount of nickel ion in the range of 3.5g/l. - 10 g/l according to the amount of Fe ion so that it may become the range of 6-8 about the ratio (the amount of nickel ion / the amount of Fe ion) of nickel ion and Fe ion.
[0024] Drawing 2 is pH of a plating bath. It is drawing explaining a value and the magnetic properties [nickel content (wt%) and magnetostriction constant lambdas and specific resistance rho] of the generated plating film. It is pH although a so big change is not given to the magnetic properties of a plating film in itself [of pH / value] so that this drawing 2 may show. As for a value, 2.5-3.0 are desirable. This reason cannot obtain a good plating film in order to make a plating ground film corrode, when the value of pH becomes lower than 2.5, and it is 3.0. If it becomes high, the solubility of a under [the plating bath of divalent Fe ion] will decrease, and it changes to trivalent Fe ion which does not contribute to plating too, a hydration oxide precipitates, and it is because it is not desirable.
[0025] Drawing 3 is drawing explaining the current density at the time of plating, and the property of the generated plating film, and explains this hereafter.
[0026] The magnetic properties of the film by the current density at the time of plating have a large current density dependency by the amount of Fe ion of a plating bath, when the amounts of Fe ion are 0.4 g/l and the plating bath which are. That is, when the amounts of Fe ion were 0.4 g/l and the plating bath which are, as drawing 1 explained, it is pH of a plating bath. In respect of calling it change, the change is small satisfactory. However, as shown in drawing 3 in this case, a ****** current density dependency is large to the magnetic properties of the plating film that nickel content of the film generated with the increase in current density increases, and specific resistance falls, and industrially disadvantageous for them. And when the amount of Fe ion is increased with 1.2 g/l and 2.3 g/l, it can avoid making the magnetic properties of the plating film generated produce most ****** current density dependencies so that drawing 3 may show.
[0027] Moreover, pH of the plating bath explained by drawing 1 and drawing 3 When time change and change of the property of the generated plating film by current density were taken into consideration, as for the proper amount of Fe ion of a plating bath, it turns out that the minimum is [0.5 g/l and an upper limit] 1.6 g/l. If the amount of Fe ion is this range, as it is shown in drawing 3 , they are current density 5 mA/cm2 - 30 mA/cm2. In the range, things can do the magnetic properties of the film generated smoothly with a thing equivalent to the case where there are many conventional amounts of Fe ion.
[0028] It is current density 5 mA/cm2 If it is made small, in order for the coercive force of the film generated to become large and to obtain 2 micrometers - 5 micrometers of desired thickness, it is not practical by plating taking a long time. Moreover, if current density is made larger [mA / 30 / // cm] than 2, composition of the film generated becomes unstable, especially, nickel will exceed 50wt(s)% and membranous specific resistance will be reduced.
[0029] Although the explanation to the above-mentioned is an example in the case of galvanizing a flat magnetic film on a flat substrate, when forming the actual magnetic head by the galvanizing method, the frame galvanizing method is adopted and it is galvanized by the direct magnetic-core configuration. For this reason, unlike a flat plating film, it becomes easy to turn to magnetization by the configuration magnetic anisotropy resulting from a magnetic-core configuration in the membranous stress direction. 40 - 50%nickel-Fe generated by the above-mentioned galvanizing method membranous intrinsic stress -- tensile stress -- it is -- a membranous magnetostriction constant (lambdas) -- +50x10~7 ** -- since it has the positive big value to say, the magnetic-domain structure of the point (truck section) of a magnetic core

is not [that it is easy to turn / magnetization / the] to the longitudinal direction of a truck / desirable to RF excitation
[0030] this invention person etc. found out that the magnetic-domain structure of a magnetic core could be rationalized by heat-treating in a time magnetic field predetermined at temperature predetermined [after plating], in order to cope with change of the above-mentioned magnetic-domain structure.
[0031] Drawing 4 is drawing explaining an example of the magnetic-domain structure of a magnetic core, and heat treatment temperature and change of membranous magnetic properties (coercive force and specific resistance), and explains this hereafter.
[0032] When the processing time was too long, the grain growth was caused, heat treatment temperature passed low, or the uniaxial anisotropy disappeared [rationalization of short ** past ** and magnetic-domain structure had the inadequate processing time, and / **** / that heat treatment temperature is too high], and heat treatment in the magnetic field over the generated film showed that coercive force increased and was not desirable. This heat treatment had impression magnetic field 2kOe, the processing temperature of 180 degrees C - 300 degrees C, and the proper processing times 0.5h-3h. Moreover, when Co not more than 10wt% is added, a membranous anisotropy field (Hk) becomes large, it becomes easier to rationalize the magnetic-domain structure after heat treatment, and little addition of Co is desirable.
[0033] The magnetic head produced as mentioned above is the record frequency of 45MHz. It is possible to use it in the above RF field, and supply of the magnetic storage which has the performance which was excellent by carrying this magnetic head in a magnetic disk unit was attained.
[0034] Drawing 5 is drawing showing the magnetic properties and specific resistance of the plating film which added and galvanized the sodium molybdate, the sodium tungstate, or the chromium chloride during the plating bath.
[0035] 40 - 50%nickel-Fe generated by the galvanizing method mentioned above independent [in at least one of a sodium molybdate, a sodium tungstate, or the chromium chlorides] during a plating bath, in order to raise the specific resistance of a magnetic film further -- or it galvanized by mixing and carrying out 0.01 g/l-1.0 g/l addition
[0036] In this case, Mo, W, and Cr The specific resistance of a magnetic film could be increased almost linearly by addition, rho showed about 65 microomegacm with the composition containing Mo:3wt% of the obtained magnetic film, and Bs was about 1.45T then. W and Cr When addition or these were mixed and it added, the almost same result was able to be obtained.
[0037] Mo, W, and Cr Independent [at least one] or about 1.4 when not adding rho of the magnetic film obtained by mixing and adding It was checked that it could be made large to about twice, consequently the frequency characteristic (micro-f property) of permeability had been greatly extended to the RF side.
[0038]
[Example] Hereafter, the example of the manufacture method of the thin film magnetic head by this invention is explained.
[0039] Table 1 is a table showing the plating bath composition and the plating conditions by the 1st example of this invention.
[0040]
[Table 1]

表 1

試　薬	配合量(g/l)
$NiCl_2 \cdot 6H_2O$	23.8
$NiSO_4 \cdot 6H_2O$	11.3 (Ni^{++}:8.4)
$FeSO_4 \cdot 7H_2O$	5.5 (Fe^{++}:1.1)
ホウ酸	25
NaCl	25
サッカリン ナトリウム	1.5
ラウリル硫酸 ナトリウム	0.1

めっき条件	
浴温度	30℃
pH	3.0
電流密度	15mA/cm²

[0041] As the metal ion concentration of the plating bath used for the 1st example of this invention was shown in Table 1, the amount of Fe++ was adjusted so that the amount of 1.1 g/l and nickel++ might serve as 8.4 g/l (ion ratio : nickel++/Fe++: 7.6). Moreover, other additives are as being shown in Table 1. pH of a plating bath was adjusted to 3.0 using HCl solution, and temperature of a bath was made into 30 degrees C which is easy to manage (although changed to 25-30 degrees C, there was so big no difference in the property of a magnetic film). And 15 mA/cm2 It galvanized by having set it as current density, and the magnetic film was made to generate.
[0042] the magnetic film obtained by this -- the composition -- 44.9 nickel-Fe (wt%) it is -- the coercive force of difficult shaft orientations showed the property in which 0.6Oe(s) and the anisotropy field were excellent in with 8.4Oe(s), and specific resistance was excellent with 44micro omegacm Moreover, saturation magnetic flux density was as high as 1.6T, and the magnetostriction constant was +46x10~7.
[0043] Table 2 is a table showing the plating bath composition and the plating conditions by the 2nd example of this invention.
[0044]
[Table 2]

表 2

試　薬	配合量(g/l)
$NiCl_2 \cdot 6H_2O$	23.8
$NiSO_4 \cdot 6H_2O$	11.3 (Ni^{++}:8.4)
$FeSO_4 \cdot 7H_2O$	5.5 (Fe^{++}:1.1)
モリブデン酸ナトリウム	0.1
ホウ酸	25
NaCl	25
サッカリンナトリウム	1.5
ラウリル硫酸ナトリウム	0.1

めっき条件	
浴温度	30℃
pH	3.0
電流密度	15mA/cm²

[0045] The 2nd example of this this invention is 45 nickel-Fe generated by the same plating bath composition as the case of the 1st example of this invention. 0.1 g/l is added for a sodium molybdate in order to increase membranous specific resistance (rho) further, without spoiling the magnetic properties of a magnetic film.
[0046] the magnetic film obtained by this -- the composition -- 43nickel-55Fe-2Mo (wt%) it is -- for the coercive force of difficult shaft orientations, 0.33Oe(s) and the anisotropy field were [7.0Oe(s) and specific resistance] 60microomegacm Moreover, saturation magnetic flux density is 1.5T although it is low compared with the film obtained when Mo was not added. It can secure and the magnetostriction constant is slightly reduced with +42x10~7. Thus, the specific resistance of a magnetic film can be raised, without spoiling the magnetic properties of 45% nickel-Fe which serves as the base by adding Mo. This inclination hardly changed, when W and Cr were added, or when Mo, W, and Cr were mixed suitably and it added.
[0047] Drawing 6 is the perspective diagram and cross section showing the composition of the 1st which this invention mentioned above, and the magnetic head manufactured according to the 2nd example. drawing 6 -- setting -- 10 -- the magnetic head and 20 -- an up magnetic core and 21 -- a lower magnetic core and 22 -- for an electrode and 25, as for a slider and 27, a coil and 26 are [a lower shield and 23 / a magnetoresistance-effect type element and 24 / an end-winding child and 28] insulator layers
[0048] The magnetic head 10 shown in drawing 6 is the record / reproduction discrete-type thin film magnetic head, and is constituted by the head for record with the coil 25 inserted and arranged between the lower magnetic cores 21 and the up magnetic cores 20 which serve as the up shield which puts on the head for reproduction by the magnetoresistance-effect type element 23 by which was pinched by the electrode 24 and **** arrangement was carried out on the lower shield 22 on a slider 26, and this head, and is arranged, and these cores.
[0049] And using the plating bath of the 1st of this invention mentioned above, or the 2nd example, it is formed by frame plating and the magnetic cores 20 and 21 which constitute the head for record are 2kOe(s) after formation and about an impression magnetic field. It is the conditions which carried out and made processing temperature 230 degrees C, and heat treatment of 1 hour was performed. In addition, the magnetic-domain structure of magnetic

cores 20 and 21 was equivalent to what was shown in drawing 4 .
[0050] Thus, the manufactured magnetic head is included in a magnetic disk unit, and it is coercive force:2.5kOe at the record frequency of 80MHz. It recorded on the medium and the record performance was evaluated. Consequently, when the 1st of this invention mentioned above and which 2nd example were used, -40dB could be secured for the over-writing performance, and it was good. Moreover, as a result of carrying this record / reproduction discrete-type thin film magnetic head in a magnetic disk unit, it has checked that it was fully equal to fast transmission.
[0051] In addition, although the explanation about the composition of the magnetic recording medium manufactured by the above-mentioned is omitted, other composition can be constituted as the same that what is necessary is just to constitute using the thin film magnetic head manufactured by this invention as the thin film magnetic head for record of record / reproduction discrete-type magnetic head of the magnetic disk unit in the conventional technology.
[0052]
[Effect of the Invention] As explained above, the magnetic-thin-film material which according to this invention is the high saturation magnetic flux density suitable for high recording density-ization in a RF field, and has high specific resistance can be obtained by the low cost frame galvanizing method, and rapid access and the thin film magnetic head which can respond to fast transmission can be obtained possible [performing record of high recording density in a RF field] also to the record medium of high coercive force.
[0053] Moreover, a magnetic disk is 4000rpm by using the above-mentioned thin film magnetic head at the time of record and reproduction of a fast transmission and the magnetic disk unit which can attain high recording density, i.e., a magnetic disk unit. It can rotate above and the record frequency of a recording head can obtain the magnetic storage which can be set as 45MHz or more. And this magnetic storage can secure 15 or more MB/s of media transfer rates.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing explaining time change of pH of the plating bath at the time of changing Fe ion concentration of a plating bath.
[Drawing 2] pH of a plating bath It is drawing explaining a value and the magnetic properties of the generated plating film.
[Drawing 3] It is drawing explaining the current density at the time of plating, and the property of the generated plating film.
[Drawing 4] It is drawing explaining an example of the magnetic-domain structure of a magnetic core, and heat treatment temperature and change of membranous magnetic properties (holding power and specific resistance).
[Drawing 5] It is drawing showing the magnetic properties and specific resistance of the plating film which added and galvanized the sodium molybdate, the sodium tungstate, or the chromium chloride during the plating bath.
[Drawing 6] It is the perspective diagram and cross section showing the 1st of this invention, and the composition of the magnetic head manufactured according to the 2nd example.
[Description of Notations]
10 Magnetic Head
20 Up Magnetic Core
21 Lower Magnetic Core
22 Lower Shield
23 Magnetoresistance-Effect Type Element
24 Electrode
25 Coil
26 Slider
27 End-Winding Child
28 Insulator Layer

[Translation done.]